ForeSight

This chapter provides information on the ForeSight network management software. The information is organized into the following sections:

- Product Overview
- Product Numbers

Note Documentation for ForeSight is available in two forms: on a CD-ROM called Cisco Connection Documentation, Enterprise Series and printed books. A CD and hard-copy installation documentation ship with each chassis, and a configuration note ships with each component ordered. All configuration notes are available on the CD. Additional CDs and a subscription CD update service are also available.

You can also access Cisco technical documentation on the World Wide Web URL http://www.cisco.com. For more information, see the chapter "Documentation" at the end of the catalog.

Product Overview

ForeSight is a revolutionary bandwidth management technology which improves the quality and efficiency of ATM wide area networks. It is a rate-based, closed-loop traffic control mechanism which continuously monitors ATM trunk utilization and adjusts the rate of each ATM connection to avoid trunk congestion and make maximum use of network resources.

The benefits of ForeSight include:

- Reduced delay: Minimizes network queuing delays which impact all connections
- Fairness: Allocates bandwidth fairly in proportion to connections' committed rate
- Efficiency: Carries more data traffic without performance degradation
- Predictability: Prevents bursts of data on one connection from "freezing-out" other connections
- Reliability: Reduces or eliminates discards caused by network congestion
- Standards compliance: maintains interoperability with user equipment

The benefits of closed-loop feedback mechanisms stem from the use of separate queues for each ATM connection. Connection-based queuing establishes firewalls among network users, ensuring predictable quality of service under all operating conditions, and allowing precise management of connection bandwidth. Maintaining and servicing these connection queues at broadband speeds requires powerful queue service engines on interface modules.

Reduced Delay

Consistently low end-to-end delay is essential for any wide area network supporting interactive, transaction-oriented applications, particularly new client-server applications where a single transaction may involve large amounts of data. Many common LAN protocols also require low delay to provide satisfactory performance over wide area network links. ForeSight guarantees consistently low delay under all network conditions.

A major source of delay in ATM wide area networks is the queuing delay which occurs at ATM trunks. ForeSight minimizes network queuing delays by adjusting the bandwidth of the connections to match the available capacity. When connections exceed their assigned bandwidth, the excess cells are buffered at the edge of the network, maintaining low delay for other connections.

Fairness

ATM networks should ensure that the bandwidth is shared fairly among all connections. Without closed-loop feedback, switches can only ensure that each connection will get at least a committed rate by policing cells at ingress and discarding cells if congestion occurs.

ForeSight goes beyond this to ensure that network bandwidth is allocated to connections in proportion to their committed rate. Any spare capacity is shared equally, and if network failures or under-provisioning of bandwidth make it impossible to give each connection its committed rate, ForeSight ensures that each will get the same fraction of the committed rate. ForeSight guarantees users equal access to network capacity without impact by other users.

Efficiency

Trunk bandwidth is a large component of the operating cost for any wide area network, and should be used as efficiently as possible. ForeSight maximizes network efficiency and lowers operating costs by enabling more data to be sent on each trunk. By intelligently distributing buffering in per-connection queues throughout the network, ForeSight prevents momentary bursts of traffic from causing network congestion and data loss. Reliable ATM services can be delivered with trunk utilizations above 90%, enabling more data to be carried over a given network. Without ForeSight, ATM trunks must operate at low average utilizations of 50% or 60% to avoid performance crippling cell discards.

Predictability

Although ATM wide area networks share bandwidth among many applications and connections, each should receive predictable service as though it were attached to a dedicated network. Connections must be isolated from each other so that one misbehaved connection cannot disrupt the performance of another.

By buffering bursts of traffic at the edge of the ATM network in separate queues for each connection, and by minimizing network queueing delays, ForeSight establishes "firewalls" and prevents bursts of traffic on some connections from affecting the performance of others.

Reliability

Reliable delivery of user data is critical to the performance of any data application. When cells are discarded within an ATM network because of network congestion, the corresponding data frames must be retransmitted. This reduces application throughput and wastes network bandwidth.

The effects of cell loss due to network congestion include:

- Reduced transmission rate
- Protocol time-outs
- Unpredictable delays
- Wasted bandwidth

Most ATM switches rely on cell discard (cell loss priority) as their primary means of congestion control. Connections which transmit above their committed rate have cells tagged as discard eligible. Even momentary congestion at a switch may cause these cells to be discarded.

ForeSight continuously monitors ATM trunk queues and adjusts connection rates to avoid network congestion. Per-connection queues guarantee each connection a minimum amount of buffering. This enables application protocols to adjust their transmission rate in response to increasing delay, before cell discards becomes necessary. Connections can support sustained transmissions above their committed rate without performance degradation due to cell loss.

Standards Compliance

ForeSight enhances the operation of ATM data services, including ATM and Frame Relay, while maintaining interoperability with user equipment and other switches that do not yet support this level of traffic control. Other standards-defined ATM traffic/congestion control mechanisms that are supported include:

- Usage Parameter Control
- Peak Cell Rate
- Sustained Cell Rate/Maximum Burst Size

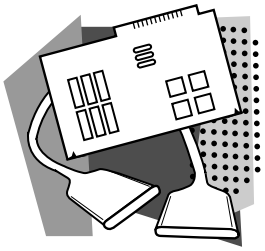
- Cell Tagging
- Selective Cell Discard
- Explicit Forward Congestion Indication

How ForeSight Works

ForeSight is the world's first rate-based, closed-loop traffic control mechanism for ATM networks, a type of ATM traffic control which coordinates congestion management among multiple switches. Closed-loop traffic controls compliment existing ATM traffic controls such as cell-tagging and selective cell discard, improving network quality of service and efficiency. ForeSight enhances the performance of all ATM-based data services, including frame relay and other AAL5 traffic.

ForeSight continuously monitors the utilization of ATM trunks, and sends information on the utilization of intermediate switches in the direction of cell transfer using congestion indicators in each cell. Destination switches use these congestion indications to track the congestion state in the forward direction of each ATM virtual circuit. This congestion state information is relayed back to the traffic source via resource management (RM) cells up to 50 times per second. The sources then adjust the sending rate of each virtual circuit based on this feedback, and buffer any additional data in per-connection queues.

The combination of per-connection queueing at ingress and rapid, cell-based feedback enables ForeSight to prevent congestion even at broadband speeds. Extensive modelling and deployment in production networks throughout the world has demonstrated the benefits of closed-loop traffic control. Cisco is working with leading vendors and the ATM Forum to extend this capability to ATM hubs, workstations and other devices.



Product Numbers

Table 239 lists the product numbers you can use to order ForeSight.

Table 239 ForeSight Product Numbers

Description	Product Numbers
AXIS ForeSight License for each Frame Service Module	AX-FS-4
BPX ForeSight License per 2 port T3 or E3 ASI card	BPX-FS-2
Frame Relay ForeSight Software License per T1/E1	IGX-FS-1